REMARKS/ARGUMENTS

This Amendment is in the newly approved Revised Format such that each section of this Amendment begins on a separate sheet.

Claims 1-10, 12-21 and 23 are pending in the present application.

More particularly, by the foregoing amendments, Claims 11 and 22 have been cancelled from the present application and Claims 1-6 and 12 have been amended as follows. Independent Claim 1 has been amended to include the subject matter of cancelled Claim 11 and to clarify the novel features of the present invention. Dependent Claims 2-6 have been amended to clarify and conform certain claim language. Independent Claim 12 has been amended to include a portion of the subject matter of cancelled Claim 22 and to clarify the novel features of the present invention. Lastly, new Claim 23 has been added to further clarify the novel features of the present invention. It is believed that none of the foregoing amendments introduces any new matter into the present application.

It is further noted that, by the foregoing amendments, paragraph [0044] of the present specification (as published under U.S. Patent Application Publication No. US 2002/0001555) has been amended to correct a typographical error discovered during Applicants' attorney's review of the present application. This amendment to the present specification does not introduce any new matter into the present application.

Claim Rejections Under 35 U.S.C. §§ 102(b) and 103(a)

On pages 2-4 of the Office Action, the Examiner rejected all of pending Claims 1-22 under 35 U.S.C. § 102(b) as being anticipated by, or in the alternative, under U.S.C. § 103(a) as being unpatentable over Nero, et al. (U.S. Patent Application Publication No. US 2001/0006614) and, independently, Carlson (U.S. Patent No. 2,797,148). Applicant respectfully traverses these rejections for the following reasons.

As recited in amended independent Claim 1, the present invention relates generally to a process for the recovery of ammonia from a reactor effluent stream. More particularly, the process of the present invention comprises the step of contacting a gaseous reactor effluent stream containing ammonia with a first aqueous ammonium

phosphate solution having a pH of about 3.5 or less, in a quench zone, to absorb substantially all of the ammonia present in the reactor effluent stream. This contacting step results in formation of a second aqueous ammonium phosphate solution richer in ammonium ions than the first aqueous ammonium phosphate solution. A further step of the process of the present invention, as recited in amended independent Claim 1, is contacting the second aqueous ammonium phosphate solution with a stripping gas, which is substantially free of carbon dioxide, to remove volatile impurities contained in the second aqueous ammonium phosphate solution. The process of the present invention, as recited in amended independent Claim 1, also comprises the step of heating the stripped second aqueous ammonium phosphate solution to an elevated temperature sufficient to reduce the amount of ammonium ions therein back to substantially the same level present in the first aqueous ammonium phosphate solution and thereby generate a vapor stream comprising ammonia and an aqueous stream.

In addition, as recited in amended independent Claim 12, the present invention relates generally to an alternative process for the recovery of ammonia from a reactor effluent stream comprising the step of contacting a gaseous reactor effluent stream containing ammonia with a first aqueous ammonium phosphate solution having a pH of about 2 or less, in a quench zone, to absorb substantially all of the ammonia present in the reactor effluent stream. This contacting step results in formation of a second aqueous ammonium phosphate solution richer in ammonium ions than the first aqueous ammonium phosphate solution. The process, as recited in amended independent Claim 12, also includes the step of heating the second aqueous ammonium phosphate solution in a stripping zone to remove volatile impurities contained therein and to form a stripped second ammonium phosphate solution. Furthermore, as recited in amended independent Claim 12, the stripped second ammonium phosphate solution is heated in a decomposition zone, to an elevated temperature sufficient to reduce the amount of ammonium ions therein back to substantially the same level present in the first aqueous ammonium phosphate solution, thereby generating a vapor stream comprising ammonia and an aqueous stream.

In addition, as recited in new independent Claim 23, the present invention relates generally to another alternative process for the recovery of ammonia from a reactor

effluent stream comprising the step of contacting a gaseous reactor effluent stream containing ammonia with a first aqueous ammonium phosphate solution having a pH of about 2 or less, in a quench zone, to absorb substantially all of the ammonia present in the reactor effluent stream. This contacting step results in formation of a second aqueous ammonium phosphate solution richer in ammonium ions than the first aqueous ammonium phosphate solution. The process of the present invention, as recited in new independent Claim 23, also comprises a heating step which is the same as in amended independent Claim 1.

As discussed and explained in the specification of the present application, the problem solved by the process of the present invention, as recited in amended independent Claims 1 and 12 and new independent Claim 23, is to reduce and/or minimize the formation of ammonium carbamate, a corrosive agent which aggressively attacks piping and equipment, as well as causing other problems, in ammonia recovery processes (see page 2, line 25 to page 3, line 8, of the present specification). In addition, at page 5, line 5, Equation 1 and lines 20-21, as well as at page 7, lines 8-16, of the present specification, Applicants also explain that, since ammonium carbamate is formed by reaction of ammonia with CO_2, formation of ammonium carbamate can be minimized by, among other things, minimizing absorption of CO_2 in the process streams of ammonia recovery processes. Thereafter, on page 7, lines 8-14 of the present specification, Applicants further explain that in a process which uses a first aqueous ammonium phosphate solution having a pH or less than about 3.5 for the quenching of the ammonia-containing effluent stream, the low pH will block absorption of all weak acidic species, including carbonic acid (which is the aqueous form of CO_2) into the subsequent process streams. Thus, the present specification teaches that using a first quench solution having a low pH (i.e., 3.5 of less) will minimize CO_2 absorption which will, in turn, minimize formation of ammonium carbamate, thereby reducing or eliminating the negative effects caused by the presence of ammonium carbamate in ammonia recovery processes.

In addition, where the ammonia recovery process includes contacting the second solution to a stripping gas, a further method for reducing the absorption of CO_2 into the ammonia recovery process streams, and thereby minimizing formation of ammonium

carbamates, is to use stripping gas that is substantially free of CO_2, in accordance with the process of the present invention as recited by amended independent Claim 1. The combination of using a first quenching solution having a pH of about 3.5 or less and a stripping gas substantially free of CO_2 , as recited in amended independent Claim 1, serves to further minimize absorption of CO_2 in the ammonia recovery process streams, thereby further minimizing formation of ammonium carbamate.

It is respectfully submitted that neither of the prior art references cited by the Examiner in the Office Action (i.e., Nero, et al. and Carlson) anticipate or make obvious the process of the present invention, as recited in amended independent Claims 1 and 12 or new independent Claim 23. Neither Nero et al or Carlson address the aforesaid problem of minimizing formation of ammonium carbamate, or its solution, let alone the particular solution provided by the present invention.

More particularly, neither Nero et al. nor Carlson teach or suggest the use of a first ammonium phosphate solution having a pH of about 3.5 or less and the use of a stripping gas substantially free of CO_2, in an ammonia recovery process according to the present invention as recited in amended independent Claim 1. Furthermore, neither Nero et al. nor Carlson teach or suggest the use of a first ammonium phosphate solution having a pH of about 2 or less, in an ammonia recovery process according to the present invention, as recited in amended independent Claim 12 and new independent Claim 23. As explained hereinabove, the novel features of the processes of the present invention minimize the absorption of CO_2 and, in turn, the formation of ammonium carbamate in ammonia recovery process streams.

Nero et al. relates to an ammonia recovery process that includes quenching a reaction effluent stream with a first aqueous ammonium phosphate solution, thereby resulting in formation of a second ammonium phosphate solution having a greater number of ammonium ions than the first solution, and then heating the second solution to reduce the number of ammonium ions. At least a portion of the post-heated second solution is recycled and combined with the first ammonium phosphate solution to feed the quench column. The method and disclosure of this reference focus on a particular method of measuring the ratio of ammonium ions to phosphate ions (i.e., the "N:P ratio", which is correlatable to the pH of the solution) in the post-heated second solution by

using a ^{23}P nuclear magnetic resonance detector, for the purpose of controlling the heating step to, in turn, control the aforesaid ratio within acceptable limits. This control of the N:P ratio in the post-heated second solution allows adjustments to be made to the N:P ratio such that, when the post-heated second solution is recycled and combined with the first ammonium phosphate solution, the N:P ratio of the first solution can, ultimately, be controlled.

In particular, Nero et al. teach that the suitable range for the N:P ratio of the first solution is from 0.7 to 1.3, which, according to Nero et al., corresponds to a pH of from 2 to 6. There is, however, no discussion of why such an N:P ratio (or such a pH level) is desirable, nor that a lower pH would be particularly desirable. Furthermore, although Nero et al. teach that the ammonia recovery process may include a stripping step, Nero et al. state that suitable stripping gases include propane, nitrogen, carbon dioxide, carbon monoxide, or mixtures thereof (see paragraphs [0046] and [0056] of Nero et al.). By including carbon dioxide (CO_2) among the possible stripping gases, Nero et al. actually teach away from the present invention, as claimed in amended independent Claim 1.

In contrast, the process of the present invention, as recited by amended independent Claim 1, requires the use of a first ammonium phosphate solution having a pH of about 3.5 or less, and the use of a stripping gas which is substantially free of CO_2, which steps serve to minimize absorption of CO_2 and, in turn, minimize formation of ammonium carbamates, which is harmful to ammonia recovery process equipment and disruptive to the ammonia recovery process.

Moreover, the present invention as recited in independent Claims 12 and 23 requires the use of a first ammonium phosphate solution having a relatively low pH, i.e., a pH of about 2 or less, which is not disclosed or suggested by Nero et al. As mentioned hereinabove, there is no discussion or suggestion provided by Nero et al. to suggest the importance of using a first ammonium phosphate solution having a relatively low pH to minimize CO_2 absorption and ammonium carbamate formation, and, more particularly, there is absolutely no discussion or suggestion concerning keeping such pH to a level of about 2 or less.

Based upon the foregoing discussion and explanation, it is submitted that Nero et al. does not anticipate or make obvious the process of the present invention, as recited in amended independent Claims 1 and 12 and new independent Claim 23. Thus, it is respectfully submitted that amended independent Claims 1 and 12, as well as dependent Claims 2-10 and 13-21, which depend either directly or indirectly from Claims 1 and 12, respectively, and new independent Claim 23, are all allowable over Nero et al.

With reference to the other reference cited by the Examiner, Carlson teaches a process for recovery of ammonia using a first ammonium phosphate solution having a pH of about 6 (see Carlson, sentence spanning Col. 2-3) and using a stripping gas which is preferably steam (see Carlson, Col. 2, lines 4-6). Thus, Carlson fails to disclose or suggest the use of a first ammonium phosphate solution having a pH of less than 3.5 (as in amended independent Claim 1) or less than 2 (as in amended independent Claim 12 or new independent Claim 23). Thus, Carlson neither anticipates, nor makes obvious the present invention as recited in independent Claims 1, 12 or 23. Moreover, although Carlson teaches the use of steam as a stripping gas, the possibility that the steam may include a substantial amount of CO_2 is not foreclosed since Carlson fails entirely to discuss or suggest the effect or importance of using a stripping gas which is substantially free of CO_2, as required by the present invention, as recited in independent Claim 1.

Based upon the foregoing discussion and explanation, it is submitted that Carlson does not teach or suggest the process of the present invention, as recited in amended independent Claims 1 and 12 and new independent Claim 23. Thus, it is respectfully submitted that amended independent Claims 1 and 12, as well as dependent Claims 2-10 and 13-21, which depend either directly or indirectly from Claims 1 and 12, respectively, and new independent Claim 23, are all allowable over Carlson.

Conclusion

Applicants and their attorney hereby respectfully request re-examination and allowance of Claims 1-10, 12-21 and 23. If, however, there remain any open issues which the Examiner believes can be resolved by a telephone call, the Examiner is cordially invited to contact the undersigned attorney.

No fees are believed to be due in connection with the submission of this Amendment. However, if any fees, including petition and extension fees, are due in connection with the submission of this Amendment, the Commissioner is hereby authorized to charge them, as well to credit any overpayments, to Deposit Account No. 18-1850.

An Associate Power of Attorney was previously submitted to authorize the undersigned attorney to proceed with prosecution of the present application on behalf of Applicants and their assignee.

Respectfully submitted,

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